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W6

IIIme CONFÉRENCE MONDIALE DE L'ÉNERGIE

(WASHINGTON, 7 - 15 SEPTEMBRE)

Compte-rendu d'une mission aux Etats-Unis
et résumé des rapports présentés

Le 10 octobre 1936.

#2

FOURTH WORLD POWER CONFERENCE

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Fourth World Power Conference

Quatrième Conférence Mondiale de l'Energie

LONDON

10-15 JULY, 1950

LONDRES

10-15 JUILLET, 1950

LIST OF MEMBERS

LISTE DES PARTICIPANTS

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Fourth World Power Conference

Quatrieme Conférence Mondiale de l'Energie

LONDON
10-15 JULY, 1950

LONDRES
10-15 JUILLET, 1950

Handbook and General Programme

Manuel et Programme Général

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5th WORLD POWER CONFERENCE
VIENNA 1956

DIVISION I **SECTION A**

GENERAL REPORT

Survey of the Development of the National Power Economies from 1950 to 1954

GENERAL REPORTER:
Dipl.-Ing. Dr. techn. Leopold BAUER,
Österreichische Elektrizitätswirtschafts-AG., Vienna,
in cooperation with:
Dipl.-Ing. Ignaz BREITENSTEIN,
Consulting Engineer of the Creditanstalt-Bankverein, Vienna,
Dipl.-Ing. Josef GERSTBACH,
Österreichische Elektrizitätswirtschafts-AG., Vienna,
Dipl.-Ing. Viktor GRABER,
Österreichische Elektrizitätswirtschafts-AG., Vienna,
Ing. Gustav WINTER,
Österreichische Elektrizitätswirtschafts-AG., Vienna.

I. Introduction

This general report is based upon the 38 papers, presented by 26 countries, which were received by the *Austrian National Committee* before the end of 1955[1]). Summarizing their contents into one report was not easy, if only for the reason that no uniform terms of reference had been given to the authors of the individual papers. Moreover the same physical values are measured frequently in different units and sometimes technical terms have been used, which allow of more than one meaning, and vice versa. In some cases data about the same country given by different authors did not agree exactly, nor were data given for the whole world always consistent. In papers assigned to other Divisions and Sections figures have occasionally been cited, which do

[1]) Therefore only the papers up to and including 223 A/38 as well as 262 A/34 could be dealt with, whereas the papers 280 A/39, 283 A/40, 285 A/41 and 266 A/42 could be referred to only in the form of foot-notes.

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DIVISION III SECTION L

GENERAL REPORT

Purification of Waste Water in the Production and Use of Energy

GENERAL REPORTER:

Dipl. Ing. Dr. Reinhard LIEPOLT, Director of the "Bundesanstalt für Wasserbiologie und Abwasserforschung" (Federal Institute for Hydro-Biology and Waste Water Research), Vienna — Kaisermühlen

Introductory

For Section L only three reports were submitted up to January 10, 1956. Obviously this result does not come up to the expectations of the *International Executive Council of the World Power Conference* which, on the occasion of its meeting in *Rio de Janeiro* in summer 1954, felt prompted to recommend that the problem of waste-water purification in the production and use of fuel and power should be thoroughly and comprehensively treated at the *5th World Power Conference*.

On the basis of the papers submitted and the available relevant technical literature an attempt has been made to provide in the present general report a comprehensive survey of the problems and objectives related to the purification of the waste waters. Accordingly, the following sub-divisions have been provided in the general report:

I. Waste Waters from the Coal Industry
II. Waste Waters from Coking Plant and Gas Works
III. Waste Waters from the Petroleum Industry
IV. Waste Waters from Thermal Power Stations
V. Waste Waters from Atomic Energy Plants

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DIVISION V

SECTION N

GENERAL REPORT

Some Technical Aspects of International Co-operation in the Production and Use of Energy

GENERAL REPORTER:
Dipl. Ing. Dr. techn. Benno MENGELE,
Prokurist der Siemens-Schuckert-Werke, G. m. b. H., Wien,
Honorardozent der Technischen Hochschule Wien

Introduction

By collaboration in the production and use of energy we mean primarily the exchange of energy media or electrical energy (interconnection). Secondly, it means the exchange of experience and knowledge in the field of energy production and utilisation. Thirdly, exploitation of energy resources belonging to several owners or States, such as occurs in the utilisation of the water power of a river forming State frontiers, necessitates an agreement between the respective owners. This does not involve the exchange of energy or experience, but rather a special kind of co-operation.

In dealing with technical problems affecting international co-operation in the production and use of energy in these three senses, we must take into consideration that methods of exchanging energy on a national scale are old, almost as old as humanity's need for energy, and are consequently founded on extensive experience and tradition. Thus, to avoid the presentation of an unduly bulky report we must assume that the main aspects of the techniques of energy exchanges, on a national level, are commonly known. The technical prerequisites for the international exchange of energy are to a great extent governed by the national methods employed. International exchange differs from national exchange only in a few special ways.

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FÜNFTE WELTKRAFTKONFERENZ WIEN 1956
5th World Power Conference 5e Conférence Mondiale de l'Energie

Abteilung
Section N
Sous-section

Rapport
Paper 177 N/5
Bericht

Vereinigte Staaten
United States
Etats-Unis

Power Pool Operations

By

Howard L. MELVIN

Chief Consulting Engineer, Ebasco Services Incorporated, New York

Indroduction

Though the term "Power Pool" may seem relatively modern in Electric Utility Operations, in principle the pooling or interconnected or grid operation of electric energy producing resources is practically as old as the industry itself. Through the process of growth and the economies inherent to larger sized facilities and more extensive service areas, electric systems have expanded until transmission networks have come into contact at many points. The interconnection of such lines and operation of systems in parallel constitutes the foundation of present-day power pooling operations.

The principal differences between a large, well-integrated power system and a power pool are that in the latter, two or more organizations and financial interests are involved, and technical operating problems are magnified. Nevertheless, basic objectives of a successful power pool operation and a large power system are the same, namely, to provide an adequate power supply and best practicable service at lowest practicable over-all costs.

This paper is not presented as a technical treatise but rather as a résumé of experience and as a guide in formulating new power pools and expansion of existing pools.

Benefits

The principal benefits or values, tangible and intangible, secured from power pooling operations in the attainment of desired objectives are:

a — Diversities in load characteristics permitting the supply of the combined loads with lesser total power resources.

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Abteilung / Section / Sous-section	H	Bericht / Paper / Rapport	179 H/29	Indien / India / Indes

Hydro-Electric Development in India

by
M. HAYATH,
Member (Hydro-Electric),
and
K. L. VIJ,
Director (Hydro-Electric),
Central Water and Power Commission (Power Wing)

1. Progress in Power Development

1.1. The First Twenty Years

The first major hydro-electric development in *India* was the construction in 1902 of the *Sivasamudram* Hydro-electric Scheme with an installed capacity of 4500 kW, undertaken by the State of *Mysore* primarily for supply of power to the *Kolar Gold Mines*. This scheme was followed by the *Khopoli* Hydro-electric Scheme in 1914, with an installed capacity of 50 000 kW, for distributing power in the metropolitan areas of *Bombay* and *Poona*, the scheme being due to the enterprise of *Tatas'*, the pioneering industrial magnates of the country. At the same time a number of steam electric plants sprung up in several State capitals and large towns like *Calcutta, Madras, Kanpur*, etc. Thus in the first 20 years or so the demands for power being very small and confined to urban areas, power development was limited to a large number of small and a few medium sized installations (both hydro and thermal) intended mostly for supplying domestic and small industrial loads in those areas.

1.2. The Period between the World Wars and Impact of World War II

1.21. Shortly after the end of the First World War, there was a spurt in industrial and other developmental activities in the country. In the State of

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Abteilung
Section
Sous-section H

Bericht
Paper
Rapport 180 H/30

Schweden
Sweden
Suède

Cooperation of Power Undertakings Regarding Water Regulation in Rivers and Lakes

by

Erik BLOMQVIST, managing director

and

Nils SÖDERLUND, legal adviser,

Indalsälven and Faxälven Water Regulating Association in Stockholm

Introduction

Sweden is a country relatively rich in water power. The water power suitable for exploitation has been estimated to yield a total production of 80 thousand million kWh/year. These natural resources must be regarded in relation to the fact that the country has a population which only slightly exceeds 7 million inhabitants distributed over an area of about 450 000 km².

In *Sweden*, as in other parts of the world, water power has been utilized on an ever increasing scale during recent decades. From a purely technical point of view exploitation is carried out largely in accordance with the same principles adopted in other parts of the world, though with certain modifications necessitated by the special nature of the natural conditions; these are characterized to a great extent by the relatively low heads, the extensive precipitation area and the moderate precipitation. On the other hand, the forms in which exploitation is administered and planned differ in several respects from what may be regarded as customary elsewhere in the world. Historical and legal precedents exist in *Sweden* in connection with the exploitation of water power which may be considered unique from many points of view.

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Abteilung Section Sous-section	A	Bericht Paper Rapport	223 A/38	Indien India Indes

Power Development in India — Some Problems

by
Prof. M. S. THACKER
Director, Council of Scientific and Industrial Research, Government of India

The expanding demand for power poses for the power engineer many problems and gives him exciting opportunities for examining new and novel possibilities for harnessing unutilized and under-utilized energy resources for power development. There has been a staggering rise in the consumption of energy all over the world. Rough calculations reveal that the overall consumption of energy during the century ending 1850 was twice as much as that of the average for the preceding seventeen-and-a-half centuries. A study of trends shows that the level of consumption has been continuously rising. The average increase was approximately five-fold during the subsequent century, but the annual rate of increase towards the end of 1950 was much higher. In 1954, the world consumption of energy was approximately 3,300 million tons of coal equivalent, as against the average of about 330 million tons of coal equivalent per annum for the period 1850—1950; in other words, the annual consumption level by 1950 had increased ten-fold.

The annual per capita consumption of energy of all types in *India* is of the order of only 0.47 ton of coal equivalent, which is less than $^1/_{18}$ of the per capita consumption of energy in the *USA* and $^1/_{10}$ of that in the *United Kingdom*. For raising the level even by one ton, i. e., to 1.47 tons of coal equivalent (which will even then be only less than $^1/_4$ of the per capita energy consumption in the *USA* and less than $^1/_3$ of that in the *United Kingdom*), we need to burn the equivalent of an additional 400 million tons of coal per annum. Even if we harness the potential hydro power we shall be obtaining only 90 million tons of coal equivalent, and if we utilize coal for the rest of the energy requirement, we shall be exhausting our coal reserves within a matter of decades. The problem of energy is thus a crucial one, and if we are not to resign ourselves to perpetuating the present appallingly low level of energy consumption, we are inevitably compelled to look for new energy resources which scientific discovery has unfolded.

The rising tempo of industrialization in *India* since independence and the growing desire for higher standards of living has created an unprecedented

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Abteilung Section Sous-section	H	Bericht Paper Rapport	227 H/38	Großbritannien Great Britain Grande-Bretagne

The Practical Application and Economics of Pumped Storage in Great Britain

By A. A. FULTON, B.Sc., M.I.C.E., M.I.Mech.E., F.R.S.E., General Manager, North of Scotland Hydro-Electric Board

T. G. N. HALDANE, M.A., M.I.C.E., M.I.E.E., Fel.A.I.E.E., Partner in Merz and McLellan

and R. W. MOUNTAIN, B.Sc. (Eng.), M.I.C.E., M.I.E.E., Partner in Kennedy & Donkin *)

Progress in the application of hydro-electric pumped storage has been slow in *Great Britain* compared for example with the *Continent* where about a million h. p. of pumped storage plant is in use with heads varying from 33 ft. to some 3000 ft. This has been due not so much to any failure to appreciate the value of pumped storage, but more to doubt whether, in the circumstances of the day, the various schemes studied had economic merit. A pioneering installation to demonstrate the advantage of pumping was in fact inaugurated in 1922 at *Walkerburn* on the River *Tweed*. It consisted of a 220 h. p. turbine installation operating under an 11-ft. head which, when not required for providing power for a tweed mill operating only for 50 hours per week, drove pumps to store water in a high level reservoir, 1000 ft. up. This water was then used during the working day to add a further 230 h. p. to the output available for the mill.

Much thought was given to possible schemes in *England* and *Wales* around 1930, a time when some schemes on the Continent were already taking

*) Until his death on the 13th August 1955 Mr. T. Lawrie, late General Manager of the North of Scotland Hydro-Electric Board, as one of the original co-authors of this Paper, had a considerable share in the preparatory work

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Abteilung / Section / Sous-section: L
Bericht / Paper / Rapport: 240 L/3
Großbritannien / Great Britain / Grande-Bretagne

Waste Waters from the Production and Utilisation of Fuels — Their Nature, Treatment and Disposal

by

Professor A. L. ROBERTS, Ph. D., F.R.I.C., F.Inst.F., Livesey Professor of Coal Gas and Fuel Industries with Metallurgy, University of Leeds and W. H. BLACKBURN, M.Sc., Ph.D., M.Inst.F., University of Leeds.

I. Introduction

The tremendous growth and concentration of industry during the last decade has produced a variety of problems, not the least of which is the disposal of the effluents resulting from many manufacturing processes. This has now become such an important consideration that where alternative manufacturing methods are possible, the final choice may well depend on the nature of the effluent produced. Indeed, in selecting the site for a new plant the relative ease of effluent disposal may be the decisive factor. Today it is no longer possible to regard effluent disposal as a minor detail to be given attention only after the major decisions have been taken.

In *Great Britain*, as well as in many other countries, the general question of pollution of the air and of river and marine waters by industrial wastes is causing ever increasing concern, not only to the responsible authorities but also to the general public. Existing safeguards have been strengthened, and even more stringent legislation is likely in the near future. No one will question that a determined attack on pollution is welcome and long overdue, but, in its implementation, there are bound to follow numerous technical problems, among the most serious of which will be those in some of the industries producing or utilizing fuel.

Since the last Plenary Meeting of the Conference, two Acts have been passed in *Great Britain — the Rivers (Prevention of Pollution) Act, 1951* and the *Rivers (Prevention of Pollution) (Scotland) Act, 1951* which are bound to have far reaching consequences. These Acts furnish the responsible authorities with

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Abteilung / Section / Sous-section	H	Bericht / Paper / Rapport	259 H/43	Australien / Australia / Australie

Progress on the Snowy Mountains Scheme

by

The Snowy Montains Hydro-Electric Authority

The Water Resources of the Australian Continent

The interior and western side of the Australian continent are extremely arid, the areas with sufficient rainfall for normal cultivation being largely limited to the eastern perimeter, on the coastal side of the *Great Dividing Range*, and to the semi-tropical coastal areas in the north.

Although prospective irrigation development in *Australia* is relatively limited in extent when compared with the large total area of the continent, it is of very great significance in the national economy. In any water development scheme on the Australian mainland irrigation is therefore of primary importance.

Possible hydro-electric installations on the mainland are generally limited to the narrow strip in the vicinity of the *Great Dividing Range*. The total present hydro capacity on the mainland, excluding the *Snowy Mountains* Scheme, is approximately 140,000 kilowatts, most of which is in the *Kiewa* Scheme in the southern portion of the *Australian Alps*. While there are possible local developments on some of the coastal streams on the north-eastern perimeter of the continent and possibly limited developments in the extreme north, the principal power potential lies in the eastern section of the *Australian Alps*, now being developed by the *Snowy Mountains* Scheme.

Here the mountains of the *Great Dividing Range* reach their highest point in *Australia*, the summit of *Mount Kosciusko* being at an altitude of 7,313 feet. A total of 320 square miles lies above 5,000 feet, and an area of 750 square miles is snow-covered during most winters. The *Murray* and its tributary, the *Murrumbidgee*, rise in this region and flow inland and westwards. Most of the existing Australian irrigation developments lie along these two rivers (Fig.1).

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Abteilung Section J Sous-section		Bericht Paper Rapport	100 J 3	Großbritannien Great Britain Grand-Bretagne

The Disposal of Waste Waters and Gases in a Nuclear Power Programme

by

H. J. DUNSTER, ARCS, BSc,
D. R. R. FAIR, OBE, BSc, AInstP, AKC
and
A. S. McLEAN, MB, ChB, DIH
United Kingdom Atomic Energy Authority

1. Introduction

In the last few years the world has come rapidly to the brink of a new era of prosperity; dramatically, as an act of providence, reality has come to the dream of nuclear power. And so, the hopes even more than the fears of mankind are already involved inescapably in the exploitation of atomic energy. The emergence of a new attidude — one of expectation and desire — was an outstanding feature of the *International Conference on the Peaceful Uses of Atomic Energy* held at *Geneva* in 1955 and gave good grounds for hoping that, as time goes on, the shadow of atomic warfare will recede into the background of the atomic energy scene. Certainly, the prospect of atomic power has already excited world wide interest, particularly in those countries whose energy resources are already declining as well as in the underdeveloped areas of the world. No doubt, the *World Power Conference* will devote more and more of its time in future years to these problems.

It is axiomatic that the success of any modern industrial development depends upon the quality of its scientific background; atomic energy has an almost super-scientific atmosphere. Nevertheless, it must be realised that the

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Abteilung / Section / Sous-section **H**

Bericht / Paper / Rapport **60 H/12**

Schweden / Sweden / Suède

Recent Development of Swedish Waterpower Design and Construction

By Tore NILSSON
Civil Engineering Director
Swedish State Power Board

Introduction

In *Sweden*, the greater part of the demand for electric energy is met by water power. Fuel power is ordinarily used only as a complement to the water power during dry years, and at peak load. It is estimated that in *Sweden* the development of about 80 000 MkWh water power is economically feasible. At present about 25 000 MkWh is harnessed. It is estimated that the power demand for the next years up to 1960 will increase by 1700 MkWh per annum. The half of the increase is assigned to the network of the State and the other half to municipal and private networks. The increase of the production, as far as the State is concerned, is provided for by the *Swedish State Power Board*. The experiences presented in this report, refer to the activity of the *Swedish Power Board*.

The conditions in the Swedish watercourses and the surrounding regions are such that the developments are carried out, as a rule, only for the purpose of utilizing the water power.

General Layout

The water power resources are developed mostly in the northern part of *Sweden*. The rivers there are characterized by low water flow during the winter and abundance of water in the summer months. The demand for power is greatest during the winter. Therefore, a condition for the rational development of the water-courses is that these be regulated. This calls for large storage reservoirs. To a great extent such can be provided in the lakes, in the upper

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Abteilung Section A Sous-section	Bericht Paper 59 A/13 Rapport	Großbritannien Great Britain Grande-Bretagne

Energy Resources of the United Kingdom and Trends in their Utilisation

by

The Chief Scientist's Division, Ministry of Fuel and Power

I. Introduction

In the report presented by the *British National Committee* to the *Fourth World Power Conference, London, 1950,* it was pointed out that, while reserves of coal for the future were adequate, the drain on them would increase and therefore conservation in their use was essential. It was also stated that much greater exploitation of the marginal resources of energy could be expected in the future. Since then the output of the coal industry has not increased, while the demand for energy has continued its steady rise and the need for economy and for the exploitation of alternative sources of energy has become more than ever important. The ultimate hope for the future lies in the generation of power from nuclear energy, but a difficult period has to be faced in the next two decades.

II. Estimated Energy Resources

(a) Indigenous Resources

In the previous report, a full assessment was given of the total indigenous energy resources of *Great Britain.* The sources concerned were: coal; coal methane; peat; water power; methane from fermentation; wind power; oil shale; cannel; lignite; tidal power; petroleum; natural gas.

In general, the assessment then made remains relatively unchanged. Before commenting briefly on such changes as are necessary, the existing state of energy resources is summarised in Table 1.

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Abteilung / Section / Sous-section: A

Bericht / Paper / Rapport: 56 A/12

Schweden / Sweden / Suède

Sweden's Energy Resources and Power Development Since 1950

by

Folke PETRI, Operation Chief, Swedish State Power Board
and Erik BLOMQUIST, Civil engineer, Managing Director of the Indalsälven and Faxälven Water Regulating Association

In the report to the fourth *World Power Conference* held in *London* in 1950 (Section A, Paper No. 16) particulars were given of the energy resources and power development from 1924 up to the time at which the report was isued in 1948. The present report follow the one mentioned above as regards its arrangement and contents, and supplements the latter by the inclusion of data from 1948 up to the end of 1953 and statistics for 1954 insofar as these are available. At the same time the preliminary data contained in the report for 1950 have been revised.

Area and Population

The area of *Sweden*, including inland waters, is $44{,}95 \times 10^6$ hectares (174 000 sq. miles) or, excluding inland waters, $41{,}09 \times 10^6$ hectares. It is of great importance for the production of hydro-electric power that the area of inland waters in considerable, being, in fact, almost 9% of the total area.

The population of *Sweden* on January 1st, 1954, was $7{,}192 \times 10^6$ persons and on January 1st, 1955, $7{,}235 \times 10^6$ persons, equivalent to only 0,16 person per hectare (in 1952 the figure for *France* was 0,77; in *Great Britain* 2,06 and in the *USA* 0,17) [1].

Solid Fuels

Figures for the production and import of solid fuels since 1948 are shown in Table 1.

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Abteilung / Section / Sous-section	B	Bericht / Paper / Rapport	55 B/5	Schweden / Sweden / Suède

Energy Statistics and Load Forecasting in Sweden

By

Sven LALANDER, Chief Engineer, Swedish State Power Board

and

Matts BÄRLUND, Divisional Chief, Swedish State Power Board

Available Energy Statistics

Electricity is a form of processed energy which through conversion into useful energy is used in the form of light, mechanical power, heat or chemical energy. The desired useful energy is also obtainable by means of conversion from other forms of energy. As a rule the consumer demands that form of energy which involves the minimum total costs. Taking useful energy as our starting point, therefore, we can speak of an "energy market" on which the different forms of energy compete for sales. The demand for a certain form of energy, e. g. electricity, depends on its competitive power as against other forms of energy.

Forecasts of the future trend of consumption must be based largely on a knowledge of the development achieved hitherto. This presumes that reliable consumption statistics are available. In view of this dependence upon other forms of energy it is desirable when making electricity forecasts to have access not only to reliable electricity statistics but also to consumption statistics relating to other forms of energy.

The number of consumers of energy is very large, and it is practically impossible to base regular consumption statistics upon data obtained from all consumers. One important sector of the energy market is industry, and in this field it is feasible to draw up statistical reports. For a long time past all industrial enterprises in *Sweden* have been required by law to render annually certain statistical particulars of their activities. On the basis of these figures the *Board of Trade* draws up each year a statistical report on the activities in the manufacturing and mining industry [1]. This report covers those industrial

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FÜNFTE WELTKRAFTKONFERENZ WIEN 1956

5th World Power Conference 5e Conférence Mondiale de l'Energie

Abteilung Section Sous-section	H	Bericht Paper Rapport	54 H 10	Schweden Sweden Suède

Aspects of Recent Development of Hydro-Electric Power in Sweden

By Gunnar ISAKSSON, C.E.
With AB Vattenbyggnadsbyrån,
Consulting Engineers and Architects

Introductory

Out of the total installed capacity of more than 4,400 MW in Swedish hydro-electric power plants, the State owns about 45 per cent. The remainder is in private hands such as power companies and municipal authorities.

Whereas the hydro-electric power plants of the State are designed and built by the State Power Board, the plants built by private companies or municipal authorities are generally designed by consulting engineers; only very few of the private power companies have their own designing offices. The data and opinions regarding trends and problems in hydro-electric development, given in the following, refer to the private power plants and are based on the experiences gained during the layout and design of them.

When the first steps were taken for utilization of the power resources of the Swedish rivers, it was natural that the sites selected were located on the rivers in southern *Sweden* close to presumptive consumers. By now, practically all water power resources in this part of the country have been utilized, and therefore the considerably larger water power resources in northern *Sweden* have been made use of, step by step, for production of power, partly for transmission to the south. The exploitation programme has proceeded so far north that many of the power plants now under construction are situated in our northernmost province, *Lappland*.

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Abteilung K
Section
Sous-section

Bericht 53 K/2
Paper
Rapport

Finnland
Finland
Finlande

By-Product Power Generation Boosts Multistage Evaporation Economy

by Sven-Olof HULTIN
Power and Fuel Economy Association Helsinki, Finland

During the recent years several authors have dealt with the economy of thermal compression and multistage evaporation. The bibliography at the end of this paper gives a list of papers with special reference to evaporation of spent pulp cooking liquor [2] to [9]. The authors have come to the conclusion, that thermal compression evaporation ranks first in economy compared with multistage vacuum evaporation, although some restrict their deduction to cases where cheap power is available. It is, however, not clearly stated what the economical power price limit would be.

In industrial practice today, the generation of by-product power with non-condensing turbines is rather a rule than an exception. In spite of this fact only *Frilund* [7] has taken into account the possibility of producing by-product power when comparing different methods of evaporation. The conclusions mentioned above are thus valid in isolated cases only.

The purpose of this paper will, therefore, be to investigate the effect of by-product power generation on the economy of multistage evaporation. Schematic diagrams of the alternatives to be considered are given in Fig. 1. The discussion of the problem can, of course, be applied to any kind of liquors, although the examples are taken from the pulp industry. It is only necessary to observe the main difference of the two types of liquors: the calcium-base sulphite liquor and the black liquor of the kraft process. The former has a negligible boiling point rise, whereas the black liquor, being a sodium salt solution, shows a rather high boiling point rise. The sulphite liquor requires a stainless steel apparatus while carbon steel will do for black liquor.

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Abteilung
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Paper 50 H/9
Rapport

Finnland
Finland
Finlande

Natural and Artifical Reservoirs in Finland's Grid-system

by Viljo CASTRÉN, dipl. eng., Helsinki, Finland

A. The Regulation Reservoirs of Finland up to Now

The whole inner part of *South-Finland* is covered by a lake district which lies about 75-120 m above the sea level. From this district the waters flow into the sea mainly through four rivers, namely *Vuoksi, Kymi, Kokemäenjoki* and *Oulujoki*. These rivers have until these days formed the most important source of power for *Finland's* productive life. Although the heads of these rivers are relatively small they dispose of remarkably large water masses equalized by the lakes in a natural way. This is illustrated by the fact that the percentage of lakes in these water systems accounts for 12.7-19.9%.

The lake district comprises many large lakes the discharge of which can effectively be regulated. The shores of the lakes, however, are relatively low and in general densely populated, so that the raising of the water level is not feasible. The lowering of the water level necessitates expensive works of clearing both innumerous sounds and the lowering channel of regulation.

Up to now the following regulations have been accomplished:

Reservoir	Area on the highest level km²	Max. regulation height in m	Volume millions of m³	Contens of energy millions of kWh
Saimaa	4600	1.65	7200	527
Näsijärvi	280	1.60	420	76
Pyhäjärvi	132	1.55	152	21
Oulujärvi	900	2.70	2320	485
Sotkamonjärvet	200	2.30	440	105
Ontojärvi	115	4.40	416	120
Suolijärvet	110	3.00	300	77
		Total millions of	11284 m³	1411 kWh

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Abteilung Section Sous-section	A	Bericht Paper Rapport	51 A/11	Finnland Finland Finlande

Production and Use of Energy in Finland Development Since 1950 and Prospects of the Future

By Bror NORDQVIST
Chief Engineer, Electrical Department of Ekono
(Power and Fuel Economy Association)

1. The Total Consumption of Energy in Finland

The total consumption of power and heat in *Finland* during the years 1928—1954, as based on available statistics, is shown in the appended table (Table 1).

So far, the electrical energy supply has chiefly been based on the utilization of the water power resources of the country.

In want of mineral fuels of any kind, the natural fuel resources of *Finland* are wood (as firewood, wood refuse, industrial wastes or by-products) and peat. Other requisite fuels, particularly coal and coke and liquid fuels such as motorpetrol, kerosine and fuel oil must be imported. Coke is produced in the only two gasworks of the country, with a combined output satisfying about 20% of the demand for coke. The raw material, coal, must in any case be imported.

The table lists the consumption of electric energy, mechanical hydropower, and imported and domestic fuels. By employing proper conversion factors the several amounts are finally presented in corresponding amounts of coal.

Study of the table will reveal the following development during the period 1928—1954:

Hydro-power generation increased 4.86 times
corresponding, on an average, to about 6.3% per annum.
Consumption of imported fuel increased 2.75 times
corresponding, on an average, to about 4% per annum.

Consumption of domestic fuel remained almost unchanged. The estimated "consumption of firewood in rural districts" included in this group is the same

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Abteilung Section Sous-section	B	Bericht Paper Rapport	165 B/13	Jugoslawien Yugoslavia Yougoslavie

Some Statistical Methods for Determining Water Power Resources

by
V. M. YEVDJEVIĆ Beograd, Yugoslavia

I. Determination of the Water Power Potential of a Region

The water power resources of a region may be considered as the theoretically available, the technically usable and the economically acceptable ones. The first category, the theoretically available water power usually refers to the water power offered by nature. It is usually called the gross water power (not taking into account losses). There is no generally acceptable definition of what is actually meant by the theoretically available water power. The second category is the technically usable water power, i. e. the water power used according to the standard engineering conceptions. What these standard conceptions are, what limits there are for utilising the available heads on the upstream part of the river and for what discharges the plants are to be installed, is usually not well defined. The third category embraces the water power economically acceptable for utilisation. What is economical or not is not easy to answer. Many water power plants are built today in places. which twenty years ago would not have been considered economically suitable.

Studying for about ten years the water power resources in *Yugoslavia*, the author of this report has come to certain conceptions on the three categories as well as to some results regarding the methods of water power investigation in a region. These considerations and results are exposed in the publication "Investigation methods of water power resources" (under press at the time this paper was worked-out).

1. Theoretically Available Water Power

The available water power potential which the waters of a surface have in reference to a given level (sea level, the mouth of a river, or the point where it leaves a given territory) may be first considered as the power potential of the rainfall water from the level where it reaches the ground to the reference level,

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Abteilung / Section / Sous-section J
Bericht / Paper / Rapport 130 J/6
Vereinigte Staaten / United States / Etats-Unis

Disposal of Atomic Wastes in the Atomic Energy Industry

By

Arthur E. GORMAN
Sanitary Engineer U. S. Atomic Energy Commission

and

Gordon E. McCALLUM,
Sanitary Engineer Director U. S. Public Health Service

The world-wide interest in peaceful uses of atomic energy has promise of blooming into one of the most important forces in the history of mankind. The potential uses for this newly discovered energy in the fields of medicine, biology, chemistry, metallurgy and power production seem endless. The unique conditions under which this energy is obtained and may be applied are such that its use may be expected throughout the world—even in areas where no power except that from relatively primitive sources now exists. When a force with such potentialities is emerging from the research and development stage to the realm of reality in competetive industrial application, it is well to take stock of the implications of this transition. The purpose of this paper is to present some of the problems which the atomic energy industry and the public must face during this period of world wide expansion, especially in planning new sites for its operations and in disposal of radioactive and toxic wastes products.

Future Uses of Nuclear Power

It is quite evident that the major peacetime use of atomic energy will be in production of electrical power. Since waste disposal and environmental problems are largely in proportional to the use of radioactive materials, special

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Abteilung / Section / Sous-section	A	Bericht / Paper / Rapport	178 A/30	Indien / India / Inde

Energy Resources in India

by

THE CENTRAL WATER AND POWER COMMISSION, GOVERNMENT OF INDIA

The principal energy resources of *India* are coal, lignite and flowing water. There are no natural gas resources and reserves of mineral oil are very limited. Sources of raw materials for atomic energy have been located but no quantitative estimate of energy available from this source has been made.

I. Coal Resources

The coal bearing strata of *India* have been classified by geologists into two main types — the *Gondwana* (Permian) measures, and the Tertiary measures. The principal workable coal deposits are found in the *Gondwana* series which occur mainly in *Bengal, Bihar, Madhya Pradesh, Orissa, Vindhy Pradesh*, and *Hyderabad*. Tertiary coal measures occur in *Assam*, the *Punjab* and *Kashmir*. Two Tertiary lignite deposits of some importance are those found in *Bikaner* and in the *South Arcot* district of *Madras*.

Reserves of Coking Coal

The *Metallurgical Coal Conservation Committee* appointed by the Government of *India* in 1949 has estimated the reserves of good quality coking coal at 2,750 million tons of which the utilizable quantity is about 2,000 million tons. It is most important that this limited reserve should be conserved for metallurgical purposes.

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Abteilung / Section / Sous-section	B	Bericht / Paper / Rapport	133 B/10	Vereinte Nationen / United Nations / Nations Unies

Current Problems in the Compilation of World Energy Statistics

by
Nathaniel B. CUYOL
Statistical Office of the United Nations
Department of Economic and Social Affairs

The statistics currently being sought by various groups concerned with the subject of world energy fall largely into three categories: statistics on production, processing, trade and utilization of various energy sources; statistics on energy reserves; and statistics on the relative prices or costs of different energy sources. The work of the *Statistical Office* of the *United Nations* in the energy field has been confined largely to the first of these categories. The present report therefore deals only with problems in the compilation of world statistics on the production, processing, trade and utilization of energy.

In this field, the *Statistical Office* has been called upon for a wide variety of studies, some simple, some complex. Most recently, it was asked to prepare, for the *First International Conference on the Peaceful Uses of Atomic Energy*, estimates of world energy requirements in the years 1975 and 2000 [1].

As an essential portion of this particular study, the Office found it necessary to prepare an account of the world's present energy supply, from origin to end use. It had available, for the purpose, about all the statistics on energy that have been published anywhere in the world during the past two decades. Even so, it was possible to produce only a very crude account for the world as a whole — an account in which inference, interpolation and extrapolation played altogether too large a part.

Very serious difficulties were created by the almost total absence of recent data on the *USSR*, *China* (mainland) and the countries of *Eastern Europe*. These countries, together, account for nearly a quarter of the world's energy. The data available to the *Statistical Office* concerning energy in these countries are con-

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Abteilung Section Sous-section	B	Bericht Paper Rapport	153 B/12	Polen Poland Pologne

Planning of Power System Development in Poland

by Władysław NEY

1. The Power Economy

The economy of utilization of energy-resources constitutes a problem, which already now has to be planned on a national scale for many years ahead, but in the near future will have to be planned on an international scale.

The power economy comprises the following basic items:

1. The proper utilization of the primary energy sources and the conversion of the potential energy of these sources into forms of energy which may find useful application, needed for national economy activities.
2. The energy transmission to the consumers by means of: transmission networks, transformer and converting stations, heating networks, local gas distribution systems and long distance gas-pipelines.
3. The proper utilization of energy for domestic and for industrial purposes by the consumers.

In course of the planned development of power economy, ties are arising gradually which in due time lead towards linking up the particular components of a system comprising all the differente sources and forms of energy, thus accomplishing the creation of the fundamental unity, that is the integrative power system. The exploitation conditions of the individual components of such a system are related to each other.

Fig. 1 represents the schematic diagram showing the mutual relations and ties existing in the integrative power system of a large industrial district.

The power system comprises the appliances serving the generation, transmission, distribution and consumption of the electric energy and heat-energy within a given area.

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Abteilung Section Sous-section	B	Bericht Paper Rapport	152 B/11	Polen Poland Pologne

Problems of Planned Power Economy in Poland

by
Boleslaw WITWINSKI
Projecting Engineer Research Bureau
Central Board of Rural Electrification
Warsaw

I. Introduction

In this paper the attempt is being made to illustrate the influence of the economic system on the development of power economy, the problems which arose and the way they were solved by planned economy, which is the fundamental feature of this system.

Definition of terms used and their meaning is presented at first.

The meaning of "power economy" used in this paper denotes the transformation of one form of energy into another, as well as the use of any raw materials for power production and for energy transfer. Planned economy has in this paper the following features, which must be taken into account:

(1) Common superior control over all branches of economy.

(2) This control is based on the principle of the utmost benefit to be gained for the whole of the national economy.

The following criterions have to be adopted in order to appreciate the benefits gained:

(a) the scope of the main economic effect and its importance for the development of the country,

(b) proper coordination of the considered enterprise with other branches of economy e. g. with the economy of raw materials,

(c) the time needed for the general economic benefit to become effective. This depends on the length of the building-time of the establishment.

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Abteilung Section A Sous-section	Bericht Paper 149 A/21 Rapport	Uruguay Uruguay Uruguay

Outline of the Extent of Energy Resources of the Republic of Uruguay, Proved and Probable

by

THE URUGUAYAN NATIONAL COMMITTEE

The principal source of energy in the country, actually the only one which is known well enough, is the utilization of the many waterstreams which cross our territory.

It might be pointed out that the utilization of our hydraulic resources has hardly commenced, since there is only one hydroelectric generating plant of any importance operating in the country, but there are fairly exhaustive studies, made at divers opportunities, on almost all possible hydroelectric developments.

The position of all the hydro projects of importance which have been studied are shown in Diagram 1 together with their approximate capacity. We give hereunder some information on the most important ones.

a) Hydro Plants on the Negro River

Of the rivers which run within the country, the *Negro* is the most important; it crosses the land from NE to SW; it is some 850 km long and shows a difference in elevation of 140 m.

The integral utilization of the river for electro-generation has been studied [1]. The position and other characteristics of three plants downstream from the existent plant at *Rincón del Bonete* have been determined with a certain degree of approximation. These plants, together with the one already operating, seem to be the most convenient formula for utilizing completely the lower course of the river.

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Abteilung Section Sous-section	B	Bericht Paper Rapport	132 B/9	Großbritannien Great Britain Grande-Bretagne

World Energy Statistics

By

G. H. DANIEL, D.Phil., B.Sc. *)
Chief Statistician, Ministry of Fuel & Power

This paper considers the adequacy of world energy statistics — that is, the figures for coal, oil, gas and electricity. Attention is focused, not on the independent national sources, but on the bodies of international data that present the figures for different countries alongside each other with totals for the world as a whole. A few decades ago such data hardly existed and the development of the existing material is a considerable achievement. But all statistics need periodic re-consideration. As requirements change, new growths must be planted, and because old statistics have a great capacity for perpetuating and proliferating themselves — particularly when produced by many independent organisations — drasting pruning is sometimes needed. It is appropriate that the adequacy of world energy statistics should be considered by the *World Power Conference* because this body has played a leading part in their creation. And it is appropriate that it should do so now because the statistics have had time to take shape and because in recent years new problems and new international agencies have arisen which make a general review necessary.

The present paper starts with a few reflections on present-day interests in international energy statistics and on the kind of information that is needed. It then reviews briefly the history of the existing sources and considers their adequacy. Finally, the conclusions reached and a tentative suggestion for further action are submitted for the consideration of the Conference.

*) I am much indebted to Mr. H. L. *Bell* and other officers of the *Ministry for Information* about sources to a number of friends who have kindly commented on the draft.

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Abteilung / Section / Sous-section	J	Bericht / Paper / Rapport	128 J/4	Schweden / Sweden / Suède

Atomic Energy Progress in Sweden 1945-1955

by

Harry BRYNIELSSON
Managing Director of the Swedish Atomic Energy Company

Background

Formerly *Sweden* was looked upon as a country rich in fuel. The fire-wood from the forests was more than sufficient not only for the heating of houses, but also for mining (by fire-setting) and for the iron and steel industry which used charcoal as fuel and reducing agent.

To-day, in the era of fossil fuels, *Sweden* must be considered to be poor in fuels. She practically lacks her own resources of coal, oil and natural gas and thus has to import fossil fuels for about 70 per cent of her total energy production. Wood still plays an important role in the fuel economy, not only directly for heating, but primarily indirectly. It is the raw material for the pulp and paper export industry, which brings *Sweden* about 40 per cent of her export revenue, and thus more than covers the import of fossil fuels.

Besides the fire-wood, *Sweden* has only resources generally considered to be of poor quality, namely peat, shale and a small quantity of coal with a low heat content.

Sweden is, however, rich in water power, and this circumstance in combination with the lack of fossil fuels has led to a considerable electrification of the country. To a certain extent the water power has taken over the role of fire-wood, as electrical energy is used for many thermal purposes in household and industry, where formerly wood was used.

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Abteilung / Section / Sous-section: H
Bericht / Paper / Rapport: 108 H/20
Norwegen / Norway / Norvège

Investigations on the Water Power Resources in Southern Norway regarding Inter-connection of the Power Stations

by

Sivert ISTAD, Chief Engineer

A) Preface

The calculations of *Norway's* total water power resources worked out by the *Norwegian Watercourse and Electricity Board* are based on the individual resources of power sites as isolated units, regardless of the fact that in time the power stations will all be connected to one large inter-connected system.

In Norway we have inter-connected power stations in some districts, the largest of these regions being in *South-Eastern Norway*, where about half the population of the country lives. The inter-connection of power stations obtains a better and more reliable supply of electricity.

The special hydrological conditions in *Norway* make it possible for a combined larger all-year capacity of energy when the power stations are planned and built for the purpose of inter-connection than if they were to operate as isolated units.

Following the initiative of *Fredrik Vogt*, general director of the *Watercourse Board*, a commission was formed in 1949 to investigate the sources of power in *Southern Norway* with regard to inter-connection of the region's power stations. This commission consists of forty members, among them the *Norwegian State*, the countries of Southern *Norway* and the owners of the power stations of at least 30 MW. Southern *Norway* is the part of the country South of *Tröndelag* (see figure 1).

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Abteilung Section Sous-section	H	Bericht Paper Rapport	109 H/21	Norwegen Norway Norvège

Trends in Norwegian Practice in Water Power Development

By Chief Engineer Ragnar HEGGSTAD

Introduction

During the years after the war, the period 1946 to 1956, a most intensive building of hydro-electric power stations has taken place in *Norway*. In this eleven year period nearly 2.0 million kW have been built, of which not less than 1.3 million kW in the period 1950 to 1956. Since 1946, not less than 56 new power stations have been built with installations of over 2000 kW. Of these plants 24 of the biggest are placed underground both with the power stations and the pipe lines. This is done mainly for reasons of economy as the following advantages can be achieved:

(1) Better utilization of heads, and under unfavourable ground conditions greater possibilities and elasticity in the choice of site and type of plant.

(2) Shorter pipe lines, which is of special importance with high heads and big pipe diameters. Hydraulic losses have also been reduced considerably. Where pressure shafts in rock have been used a further saving has been attained in the weight of steel for the pipes.

(3) Protection against avalanches and falling rocks.

(4) In dry, good rock details of construction such as pillars, walls, foundations, crane girders, etc. can be considerably simplified as compared with stations in the open.

(5) Maintenance and repair costs — which can after some time be considerable for plants situated in districts where the climate is unfavourable — can be reduced considerably.

In the writer's report on Norwegian underground power plants to the *World Power Conference* in *London* in 1950, a general survey was given of the usual designing of the power plants then completed or in course of construction. At that time five power plants totalling 340 MW were completed and 15 stations totalling 600 MW were in course of construction. Today 26 under-

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Abteilung Section Sous-section	A	Bericht Paper Rapport	110 A/17	Norwegen Norway Norvège

Energy Resources and Power Developments in Norway

By the Norwegian National Committee[1]

Water Power

The predominant source of power in *Norway* is water power and it is significant that at present more than 99% of the energy produced in Norwegian power-stations is hydro-electric. The watercourses have comparatively small drainage areas, but often very high heads and the average precipitation in the highest parts of the country is high. It is estimated that the country's average altitude is about 500 m above sea level, with its highest point about 2500 m. The mean annual precipitation is estimated at about 1450 mm and evaporation varies from about 150 mm per annum in the most Northerly parts of the country to 300 mm in the most Southerly. The amount of effective precipitation varies from 300 mm per annum in the low-lying inland regions to about 6000 mm in higher regions with a maritime influence.

In the inland watercourses the greater part of the winter precipitation is accumulated in the form of snow, and the stored snow, which varies greatly from one region to another, generally constitutes 30—40% of the yearly precipitation. At this time when the demand for power is at its maximum the discharge sinks to a minimum which is generally reached in March, when it can sink to about 15% of the average, on occasions to under 10%. The deficit period usually lasts for 200—270 days, with an average discharge of 20—35% of the yearly average.

The power plants must therefore secure water reserves for the low water period and large reservoirs can be made in the numerous lakes. It is estimated that fresh water lakes cover 4.4% of the country's total area. Many of the lakes lie at great heights where regulation can be carried out without much damage to cultivated areas. At present, reservoirs have been constructed

[1] The section "Water power" is prepared by the Norwegian Watercourse and Electricity Board. The other sections are based on information from the Statistical Bureau of Norway.

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Abteilung / Section / Sous-section	A	Bericht / Paper / Rapport	157 A/23	Mexiko / Mexico / Mexique

The State and Development of Power Production and Utilization in Mexico

by

Ing. Luis F. de ANDA,
Coordinator, Mexican Power Committee,
Chairman, Geothermic Power Commission

1. Brief Description of the Historical Development of the Mexican Electric Industry

Physical Evolution

The Mexican electric industry originated during the last decades of the past century. Its historical evolution is similar to that of other countries. Generally speaking, it commenced with the installation of small, private plants destined, in their majority, to satisfy industrial and mining requirements. The fact that these plants remained idle during the hours of the day when work was suspended, suggested to their owners the convenience of providing small lighting services to nearby centres of population and their inhabitants. Thus, mixed service was originated.

Once these private concerns were converted into concerns providing mixed service, they became aware of the fact that, in order to continue this mixed service, they would require the constant investment of capital to amplify their electric installations, in order to be able to satisfy adequately the increasing requirements, both of the public and of the concern itself, with the consequent result that they had to draw on resources destined for the satisfaction of specific ends related to their primary activities. This circumstance gradually caused mixed service to be abandoned.

Simultaneously, and as a result of the experiences obtained in other countries in the use of electric energy, the first concerns devoted exclusively to providing public electric services were formed in the Republic.

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Abteilung / Section / Sous-section	A	Bericht / Paper / Rapport	161 A/27	Mexiko / Mexico / Mexique

Hydraulic Resources in Mexico

by
Ing. Luis F. de ANDA
Coordinator, Mexican Power Committee
Chairman, Geothermic Power Commission

General Considerations

The *Republic of Mexico* possesses relatively abundant hydraulic resources which may be utilized for the generation of electric energy. However, to a considerable extent these have not been duly studied and, in fact, some of them are completely unknown; this is principally caused by the fact that they are situated in faraway places of difficult approach and that, owing to their distance from the present centres of consumption, no incentive existed for their study. It is estimated that the resources utilized up-to-date represent less than 10 % of the estimated total which could be utilized.

The regions which have been studied more profusely are those located principally in the centre of the Republic and along the *Gulf*, which correspond to zones of greatest density of population or of greatest industrial concentration. To a lesser degree, the zones of the Northern and Northwestern regions have also been studied. The Southern and Southeastern zones, although they probably contain the largest hydraulic resources, until now have been studied very little.

Rainfall

The principal source for hydraulic utilization is constituted by rainfall since, in *Mexico*, other types of meteorologic phenomena, such as hail or snow, lack importance. The region of greatest rainfall in the country is situated to the south of the *Gulf range*, i. e. at the Northern slopes of the *Sierra Madre of Chiapas*, where humid air currents which pass over various parts of the Mexican territory

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Abteilung
Section A
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Bericht
Paper 163 A 28
Rapport

Island
Iceland
Islande

Energy Resources and Power Developments in Iceland

by the

Icelandic National Committee

Introduction

Iceland is a large island in the *North Atlantic* ocean. The area is 103 000 km² and maximum dimensions are from east to west 490 km and from north to south 312 km. The east coast of *Iceland* is 800 km northwest of *Scotland* and the north coast is touched by the *Arctic Circle*.

Iceland is a tableland crowned by numerous glaciers and dissected by deep fjords and valleys. The mean elevation is about 500 m above sea level, and the glaciers reach in altitude up to 2 000 m and cover altogether approximately 11 800 km². The lowlands on which practically all the inhabitants live are about seven per cent of the area of the country. Approximately twenty per cent of the country is covered by continuous vegetation, mostly grassland, and the cultivated area is about 60 000 hectares of 0,6 per cent of the whole area.

Iceland is one of the most active volcanic regions in the world. It is built up of basaltic volcanic materials, and volcanism has been active continuously from the formation of the island in the *Tertiary period*. About 130 volcanoes are known to have been active in the *Postglacial period*, and about 25 have been active since the country was settled, around 900 A. D. The thermal gradient of the bedrock is approximately 0,08 to 0,10° C/m or three times that on the continents.

The climate is oceanic, humid and unsteady but mild compared to the latitude, because of the *Gulf Stream*. At *Reykjavík* the mean annual temperature is +4,5° C, the mean temperature in the coldest month —0,6° C and in the warmest month +11,3° C.

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Abteilung Section Sous-section	J	Bericht Paper Rapport	173 J/11	Vereinigte Staaten United States Etats-Unis

Considerations Involved in a First Nuclear-Electric Power Reactor in New England

by

R. Leigh FITZGERALD, Assistant to the President
New England Electric System

1. Introduction — Significance of Nuclear Reactor Project

The first nuclear power reactor for *New England* is not conceived as an important pioneering venture from the point of view of scientific or technical advances on the nuclear front. Its design requirements strive for (a) operating reliability at an early date, (b) reasonable first cost, (c) sufficient flexibility of design to enable incorporation of improvements as they are developed in the future and (d) an early completion date.

However, such a project will be a pioneering venture in the realm of business. In the free economy of the *United States*, a new corporation, like an individual, has to establish its own relationships with the public, working men, other businesses and the financial community. This must be on a basis of voluntary acceptance, of give and take. These empirical relationships may need to be supplemented by appeals to state or national legislatures for overriding grants of special rights or immunities. But up to now there has been no such thing as a private enterprise reactor company. Nuclear reactors to date have been built and operated only by an agency of the national government endowed with rights and immunities that for all practical purposes are unlimited.

Ordinarily a new enterprise opens its doors in a well established and defined business and legal environment. The requirements for success are clear cut — reasonable aptitude and concern for customer, employee and public relations, adequate financial resources and management ability.

But a business concern setting out today to build and operate a high-powered nuclear reactor must start from scratch. It must gain the confidence of neighbors who are little-informed, very likely misinformed, of employees, present and prospective, and of their labor unions. It must anticipate where existing laws and regulations will so hinder or preclude its success that it must

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Abtellung Section Sous-section	A	Bericht Paper Rapport	181 A/31	Kanada Canada Canada

Progress in the Development of the Energy Resources of Canada

by

Water Resources Branch,
Department of Northern Affairs and National Resources

and

Dominion Coal Board

Introduction

The energy resources of *Canada* and their development were reported in a paper presented at the *Fourth World Power Conference* in *London* in 1950. There have been significant changes since that time in the discovery and development of new oil and gas fields and the harnessing of large supplies of hydro-electric energy while the combination of recent discoveries of uranium with the technical developments in the production of atomic power shows promise of major growth in resources of atomic energy.

Report of Progress

Energy Sources

There has been a gradual change in the sources of energy as petroleum has taken over more and more of the market formerly supplied by coal. In Figure 1 there is a graphical record of the supply of all but one of the various forms of energy from 1926 up to and including 1953. The exception is wood which supplies a proportion of the energy requirements. Accurate data on which any estimate could be based is not available in the earlier part of the years covered by this graph.

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Abteilung		Bericht	Kanada
Section	O	Paper	182 O/4 Canada
Sous-section		Rapport	Canada

Problems of Development of International Rivers on the Pacific Watershed of Canada and the United States

by

General A. G. L. McNAUGHTON
Chairman, Canadian Section, International Joint Commission

The problems presented to *Canada* in the development of her water resources in the *Pacific Region* are partly international under the several *Treaties* which govern relations between *Canada* and the *United States* and partly national as between the federal, provincial and territorial authorities concerned with particular areas. Then, these external and internal jurisdictional aspects being resolved, there are great questions of engineering to be answered by the acquisition of comprehensive data in regions as yet only partially surveyed; also in the selection of projects which will not only make optimum use of resources within river basins but will also take advantage of the topography of the *Pacific coast* where inlets from the ocean penetrate the *Coastal Mountain Ranges* into close proximity with southern, eastern and northern drainage. The great lakes and rivers, which exist in the high valleys, open up imaginative possibilities of immense storages at high altitudes and of diversions of substantial flows to be used in the large and concentrated heads available on the *Pacific slope*. Here, the power plants may be placed in easier access for the supply of raw material to be processed and for the despatch of finished goods to markets. The milder climate and more pleasant living conditions of the coastal region, warmed by the *Japanese current*, is also a very significant advantage for the residents of the many new communities which will come into existence in consequence of the power developments.

Within the restricted limits of this paper an outline of the international and national jurisdictional aspects will be given sufficient to show the wide choice

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Abteilung Section J Sous-section	Bericht Paper 194 J/13 Rapport		Großbritannien Great Britain Grande-Bretagne

Nuclear Generation and the Future Power System in Great Britain

by

J. C. DUCKWORTH, B.A.,
P. J. SQUIRE, B.Sc., A.M.I.E.E., and
V. G. NEWMAN,
B.Sc. (Eng)., A.M.I.C.E., A.M.I.Mech.E.

Introduction

Development of the British electricity supply system has, until recently, been based on the assumption that abundant supplies of home-produced coal would be available for electricity generation. Since the War, however, it has not been possible to recruit sufficient manpower to the mines to meet the growing demands for coal, and for the last few years it has been necessary to import coal on an increasing scale.

In view of the competing demands for manpower inherent in an expanding economy requiring full employment, it is now clear that *Britain* is faced with the prospect of a rapidly increasing gap between the home production of coal and the national requirements. It follows that, of all nations, *Britain* has perhaps the most urgent need to develop nuclear power as an additional source of energy. At the most optimistic rate of development, however, nuclear power cannot be expected to make good the deficit for ten or fifteen years, and in the meantime, arrangements have been made to burn oil in a number of new stations to an extent approximately equivalent to 9 million tons of coal per annum.

Nuclear Plant Requirements

A ten year programme [1] for the commercial application of nuclear power has been formulated involving capital investment of the order of £ 300 million. This sum includes fuel processing plant and development of prototypes but excludes basic research. It envisages the installation of plants with a total output

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Abteilung Section Sous-section	A	Bericht Paper Rapport	199 A/35	Großbritannien Great Britain Grande Bretagne

The Middle East as a Factor in the Pattern of Oil Supply

by

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British Petroleum Co. Ltd.

1. Introduction

> "The centre of gravity of world oil production is shifting from the Gulf Caribbean area to the Middle East — to the Persian Gulf area — and is likely to continue to shift until it is firmly established in that area." E. DeGolyer, 1944

The *Middle East* as a geographical term has been used with many different meanings but, for convenience in this paper, it is defined as including the whole of the *Arabian peninsula* except a narrow strip along the *Red Sea Coast, Jordan, Syria, Iraq,* and those parts of *Iran* and *Turkey* which lie to the south-west or south of the high mountains of the *Zagros* and *Taurus* ranges. *Palestine* and the *Lebanon* are also regarded as part of the *Middle East* but *Egypt,* including *Sinai,* and *Central Iran* are not. This specially restricted use of the term is adopted to conform approximately with its geological structure. It is also a reasonable expectation that any contribution from adjacent areas, often included in the *Middle East,* to the world's oil supply will be small in comparison with that of this region.

Fundamentally the pattern of oil supply at any given time is the resultant of prevailing demand and available supply in terms of quality, cost and quantity. Variation in quality of crude oil may have an appreciable effect on the supply pattern in certain circumstances but, provided a crude oil falls within a rather wide bracket as regards its hydrocarbon and other components, hitherto it has been generally acceptable to the world's markets and it seems likely that such will continue to be the case. Costs of production vary widely in amount and in make-up in different parts of the world and the *Middle East* has its own characteristics in this respect. Both quality and costs of production of crude oil as they affect the *Middle East* are considered briefly but this paper is concerned mainly with the question of available quantity, since that factor

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Abteilung Section Sous-section	J	Bericht Paper Rapport	201 J/14	Niederlande Netherlands Pays-Bas

Power Reactor Development Programme in the Netherlands

by

Dr. J. J. WENT

(Kema Research Laboratories, Arnhem, Netherlands)

Introduction

In the development of power reactors economic, technical and safety problems are playing a decisive role. Furthermore it is very probable that the power reactor types under construction at the moment will be different from the systems to be used in future. Evidently the construction of real power reactors, with the present status of technological knowledge, must be conservative. Therefore, it is quite obvious that a long term power reactor development programme will be different from a short term programme.

In the *Netherlands* we believe that the economic potentialities of nuclear reactors are so important, that the choice of advanced types, even if that will result in a long term programme, is justified.

Before describing in more detail our programme in § 3 and 4, it seems to be useful to summarize the desirable properties of power reactors in general and to investigate to which extent our wishes can be fulfilled.

The economic goals (§ 1) can be divided in low capital investments and low running costs. The last one is not related to low fuel and reprocessing costs only since simplicity and reliability of the reactor construction might equally reduce the running costs.

In a densely populated country as the *Netherlands*, safety properties and precautions (§ 2), are very important and must be considered seriously.

Finally three points should be mentioned already in the introduction.

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Abteilung Section Sous-section	A	Bericht Paper Rapport	204 A/36	Indien India Inde

Brief Review of Energy Development in India

by
Prof. M. S. THACKER
Director, Council of Scientific and Industrial Research, Government of India

Introduction

Energy is the great prime mover for the various activities which determine the growth of civilization and material prosperity. The development of energy resources is closely correlated to the progress of industrialization and the magnitude of unutilized resources provides a measure of the scope for further development.

The energy from the sun constitutes the ultimate major source of power used by mankind. The sun radiates energy at the rate of about 3.6×10^{23} B.Th.U. per second, but only a very minute fraction of it reaches the earth. It is estimated that even this inconsiderable fraction of energy received in just 8 minutes is sufficient to meet the world's annual requirements! Solar energy is manifested in the formation of fossil fuels, growth of vegetation by photosynthesis, evaporation of water leading to moving water, generation of air currents and tides; the heat of the earth and atmospheric electricity are other forms in which the energy manifests itself.

Energy resources may be broadly classified into: (1) exhaustible, e. g., coal, mineral oil, peat, natural gases, etc., and (2) inexhaustible — those which are replenished by nature as fast as they are utilized, e. g., waterfalls, winds, tides and vegetation.

The total consumption of energy in the world has increased enormously during the past few decades. Table 1 gives the world production of energy according to principal sources, Table 2 gives the annual rate of increase of world energy production. Table 3 summarizes the data on the progress of electricity generation in certain countries during the period 1938—53. Table 4 gives the world consumption of primary fuels and the industrial output for the period 1913—54.

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Abteilung Section Sous-section	H	Bericht Paper Rapport	224 H/37	Großbritannien Great Britain Grande Bretagne

Some British Developments in Large Plant for Hydro-electric Power Generation

by

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Introduction

The developments described in this Paper are necessarily based on the activities of the Group with which the writer is associated. As such they are only a part of the British contribution to Water turbine development. However, as a number of important advances are described, it is felt that they will be of some interest to this Conference.

Experimental Facilities

While a Hydro electric laboratory at *Rugby* has been successfully operated since the early thirties, a review made just after the Second World War of the future possible expansion in the world demand for hydro electric plant, and of the associated development problems showed it to be imperative that these laboratory facilities be greatly extended.

A review of probable future testing requirements showed some of the equipment necessary to be as follows:

Two Berths for testing complete model turbines with 20 inch diameter runners. One berth with a tank so as to allow of an open flume setting or the convenient insertion of a model of a concrete spiral casing with flat sides. Both berths to take spirals with circular inlets and any shape of draft tube. Thus the

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Abteilung / Section / Sous-section: J
Bericht / Paper / Rapport: 239 J/16
Großbritannien / Great Britain / Grande Bretagne

Mechanical Engineering Features of the Calder Hall Nuclear Power Station

By

R. F. BISHOP, M.A., A.M.I.Mech.E.,
R. W. HORSEMAN, A M.I.Mech.E., Whessoe Ltd.,
G. W. GROSSMITH, M.C., M.I.Mech.E., Strachan & Henshaw Ltd.,
R. H. KELSALL, B.Sc., A.M.I.E.E., Metropolitan-Vickers Ltd.,
K. J. CUNNINGHAM, B.Sc., Plessey Ltd.,
W. R. WOOTON, Babcock & Wilcox Ltd.,
A. T. BOWDEN, Ph.D., B.Sc. (Eng.), M.I.Mech.E., C. A. Parsons & Co. Ltd.

With an introduction by R. V. MOORE, G.C., B.Sc., M.I.E.E., A.M.I.Mech.E., Chief Engineer, Thermal Reactor Design, United Kingdom Atomic Energy Authority.

1. Introduction

Construction of the *Calder Hall* plant began in August, 1953. Essentially the plant is made up of two gas-cooled graphite-moderated reactors, and the heat generated in the natural uranium with which they are fuelled is transferred in each case to four boilers by carbon dioxide gas under pressure. Steam from the boilers associated with each reactor is fed to two turbo-alternators, the products of the plant being electric power and plutonium. Fig. 1 shows diagrammatically the general arrangement of a reactor and its cooling circuit. The uranium channels are vertical and the cooled gas returning from the heat exchangers passes up through the graphite core, rising about 200° C in temperature, and passes out to the heat exchangers by four separate 54 in. (137 cm) diameter ducts. On passing down through the heat exchangers, heat is transferred from the gas to the water and steam. The cool gas is returned to the reactor by four 1500 h.p. centrifugal type circulators, one to each circuit.

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URSS

Fly Ash Wet Precipitators

By N. F. DERGATCHEV

Two types of fly ash wet precipitators were developed for effective cleaning of flue gases in thermal power stations from fly ash, type CS (a centrifugal scrubber) and type MP (a fly ash precipitator with wet rods).

Type CS fly ash precipitator with wet rods

A type CS fly ash precipitator consists of the following parts (Fig. 1): a housing (6,7), a hydraulic gate with rod-type grating (4), a water distribution ring with watering nozzles (2,9), windows (3), a cast iron shell consisting of several sections with a protective shield (8), an inlet connection (1) and periodically acting washing nozzles with a turning device (5).

The casing of a fly ash precipitator consists of a vertical cylinder with a conical bottom made of sheet steel.

The upper cylindrical part of the housing is welded to the exhaust volute chamber or to the collector for the cleaned flue gases; the lower conical part of the housing has a flanged bottom that is attached to a hydraulic gate for continuous disposal of the sludge accumulated in the precipitator.

A small grating is installed in the conical part of the ash precipitator to prevent fouling of the cone throat with ash that may fall from the housing walls or that may be washed down when the inlet is being flushed.

The inner surface of the ash precipitator is watered from nozzles of a special design. The number of nozzles employed depends upon the precipitator diameter. The watering nozzles are installed in the upper part of the housing so that the water spray from these nozzles will be tangent to the refractory lined inner surface of the ash precipitator. In this position the spray does not decompose into drops when coming into contact with the inner surface.

Uniform allocation of water among the nozzles is obtained by using a water distribution ring. The operation of the watering nozzles may be observed

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Abteilung Section Sous-section	M	Bericht Paper Rapport	9 M 1	Großbritannien Great Britain Grande Bretagne

Air Pollution in Great Britain from the Treatment and Use of Fuels

By A. PARKER, C. B. E.
D. Sc., M. I. Chem. E., F. R. I. C., M. Inst. Gas E., F. Inst. F.

Director of Fuel Research,
Department of Scientific and Industrial Research

Introduction

Gross contamination of the air of many of the large towns in Great Britain and of the rivers and streams that flow through them is part of the price that has so far had to be paid for the development of industry, to enable the country to support an increasing population at a rising standard of living. The area of Great Britain is less than one-five-hundredth of the total land area of the world, whilst the population is now one-fortieth of world population, so that the density of population is twelve times the average for the world.

Development of industry in the country since the beginning of the eighteenth century has been based on coal as the major source of heat and power, and it is mainly from the use of this indigenous fuel that the air of the large industrial towns has become heavily polluted. During the past 50 years, there has also been an increasing amount of pollution from the use of petroleum oils for furnaces and road transport.

Coal has been used in Britain for at least a thousand years, at first gradually and then more rapidly displacing wood as fuel. Though the quantity of coal burned was not more than a few million tons a year until 150 years ago, there were serious complaints as early as the thirteenth century about pollution of the air from the burning of coal in London. For example, nearly 700 years ago, when the annual consumption of coal for the whole country was probably no more than one million tons, there was a proclamation prohi-

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Section / Abteilung / Sous-section	Paper / Bericht / Rapport	Sweden / Schweden / Suède
M	13 M/3	

Ash Precipitation in the Västerås Power Station

by U. BLOMQUIST
Chief Engineer, Swedish State Power Board

Introduction

The *Västerås Power Station* is one of the fuel burning power units operated by the Swedish State Power Board and as such is usually required to operate intermittently for relatively short periods. In dry years, when the water power is insufficient for the requirements of the hydro-electric power plants, the *Västerås* station may have to operate for prolonged periods, especially during the winter months. The power station has been extended a number of times, and in its present stage possesses a full-load generating capacity of 220,000 kW.

During the recent extension of the plant in 1947 and 48, which included the two 65,000 kW *Stal* turbines and a separate boiler for each turbine, the question of ash precipitation was taken up anew. Because of the proximity of the station to a rapidly expanding town, it was desirable that the flue gas from the boilers, which are designed for burning pulverised coal and fuel oil of the light grade Bunker C type, should be cleansed as effectively as possible by ash precipitation. Each type of fuel being required to deliver full output when used separately or together, the problem was further complicated by the elevation of the dew point caused by the high sulphur content of the fuel oil. This circumstance is particularly noticeable on the frequent occasions of rapid starting of the plant, when the precipitators are at a temperature lower than the dew point.

The relatively short operational periods presuppose that the capital invested in the plant shall be kept at as low a figure as possible, both as

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Abteilung / Section / Sous-section: A
Bericht / Paper / Rapport: 17 A 2
Irland / Ireland / l'Irlande

The Energy Resources of the Republic of Ireland. And Power Developments up to 1955

by

THE IRISH NATIONAL COMMITTEE

A paper dealing with the Energy Resources and Power Developments of the *Republic of Ireland* was presented to the *Fourth World Power Conference* in 1950 by the *Irish National Committee*. (Reference-Paper No. 11, Section A.)

The present paper is intended to be supplementary to the 1950 paper, and the contents of the former paper are recapitulated only in so far as it is necessary to an understanding of the present power position.

Energy Resources

Ireland's natural energy resources consist of a small reserve of coal, a rather limited amount of water power, and a considerable amount of peat fuel. There is also a negligible amount of wood.

Coal Resources and Utilisation

The deposits of coal in *Ireland* are very small. There are three coal fields which are being worked, the *Arigna* coal field in the west, the *Leinster* coal field in the midlands, and the *Slieveardagh* coal field in the south. The *Irish Geological Survey Department* estimates that the workable coal resources do not exceed 18.5 million tons. The estimated output in 1954 was 191,700 tons.

The *Electricity Supply Board* is constructing a 15,000 kW power station on the *Arigna* coal field.

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Abteilung	Bericht	Japan
Section K	Paper 22 K/1	Japan
Sous-section	Rapport	Japon

The Trend of Investigation on Electric Power Generation by Subterranean Steam in Japan

By

TOSHIO YOSHIOKA

Chairman of the Subterranean Steam Power Development Research Committee of Japan

Introduction

Favoured by geology which provided her with so many volcanic regions *Japan* has carried out, incessant investigations for obtaining power from subterranean steam on an industrial scale since as far back as 1919.

This report outlines her progress in the past and the present status of investigations.

I. Short History of the Investigations

1918—1924: Mr. *M. Yamanouchi* obtained subterranean steam at *Beppu* in *Kyushu* by test boring, and Dr. H. *Tachikawa* tried to generate 2 KW of electric power with it.

1926: Dr. *H. Tachikawa* obtained powerful steam by boring at *Otake* in *Kyushu,* though it was not converted to electric energy.

1940: Dr. S. *Yamaguchi* and Dr. *F. Oda* and others cooperated in making a boring at *Shimogamo* in *Izu peninsula,* but were compelled to cease at a depth of 100 m.

1947: The *Miyagi* prefectural government planned to develop subterranean energy in the *Naruko* district, and tried electric power generation with steam vents furnished by the *Tone Boring Co.*

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5th World Power Conference 5e Conférence Mondiale de l'Energie

Abteilung Section Sous-section	H	Bericht Paper Rapport	31 H/1	Japan Japan Japon

The Present State of Hydro-Electric Power Generation in Japan

By Sadao SAEKI
Chief of Public Utilities Division,
Bureau of International Trade and Industry at Tokyo
Ministry of International Trade and Industry

1. Survey on the Hydro-Electric Power Plants in Japan

At first the hydro-electric power plants in *Japan* were of the run-of-river type with the capacity of the turbine corresponding to the minimum low water of the river. Later on it was found necessary to exploit the water power available more effectively. It was tried to attain this aim by increasing the turbine capacity of the power plant to the threefold or thereabouts of the minimum low water, by combining the hydraulic plants with thermal power stations, and by erecting weir power plants, ponds and damming reservoirs.

Considering, however, the density of the population and the craggy configuration, as well as the steep slopes at the sites suitable for water power plants the construction of sufficiently large ponds and reservoirs is virtually barred out in *Japan*. Consequently the predominant type is still the direct flow (run-of-river) water turbine, eventually combined with a thermal power stand-by plant, which is designed to eke out the seasonal shortages.

The majority of these plants is located far away from the big towns, calling for the bulk of the current generated, the distances ranging from 200 to 300 km, and the lines operating at 110, 154, or 275 kilovolts. There is a number of minor hydro-electric power plants, linked by a network of 70 kilovolts or even less, which are also used for feeding the aforesaid trunk transmission system. This integration of the power plants into joint networks has resulted in the formation of a limited number of networks, carrying loads from 300,000 to 2,000,000 kilowatts.

The north-eastern part of *Japan* operates at 50 cycles per second, whilst the south-eastern part has 60 cycles per second. In order to facilitate the

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Abteilung Section Sous-section	A	Bericht Paper Rapport	32 A/5	Japan Japan Japon

The State and Development of Electric Power Production in Japan

By Takashi FUJII
Planning Division,
Economic Planning Board

1. Hydraulic Power Resources

a) Geographical Features of Rainfall in Japan

Japan extends from south to north along the eastern side of the *Asiatic Continent*, and consists of four main islands, *Hokkaido, Honshu, Shikoku* and *Kyushu*. Considering the latitude of the country, it belongs to the temperate zone, and its climate is oceanic accompanied with comparatively much rainfall. The monsoon which comes from the *Pacific Ocean* in summer and that monsoon from the *Siberian Continent* in winter form characteristic climates on both sides of the mountains running through the country along the *Pacific Ocean* and the *Sea of Japan*. The former side has much rain in summer but less in winter, while the other has rather much rain and snow in winter. Besides, around September typhoons often visite the country, mostly accompanied with heavy rain.

The yearly rainfall classified according to districts, as shown in Fig. 1, is approximately 1,900 mm, in average all over *Japan;* in *South Kyushu, Shikoku* and *Kyushu* districts along the *Pacific*, and *Toyama* along the *Sea of Japan*, rainfall is so great that it amounts to 2,500—3,000 mm.

b) Quantity of Flow

As *Japan* is long and narrow in its feature, rivers are mostly short in length, even the longest one being below 400 km, but its precipitous feature and comparatively large river discharge make the country eminently suitable for developing hydraulic power production.

The quantity of flow per catchment basin of the main rivers is shown in Table 1, from which it will be observed that the yearly average water flow is

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Abteilung Section Sous-section	G	Bericht Paper Rapport	36 $G_1/7$	Japan Japan Japon

The Present Status of Thermal Power Generation in Japan

By KAZUTOSHI IYJIMA

Chief of Thermal Power Section
Public Utilities Bureau
Ministry of International Trade & Industry

1. Outline of Thermal Power Plants in Japan

Most of the thermal power plants constructed in pre-war days were of the type commonly called: "supplementary thermal power plants", designed to supplement the hydro-electric generation capabilities varying seasonally to a considerable degree, so that a steady supply of electricity would be maintained throughout a year. In recent years, however, special efforts have been concentrated on the development of reservoir type hydro power projects and, to go with it, on speedy construction of modern high-efficiency large capacity steam power plants, to ensure that the rapidly increasing power demand of not only recent years but also in the immediate future may be satisfactorily met and thereby a real, lasting balance between demand and supply of electricity be realised through combined operation of those newly acquired two types of power generation resources.

Through this effort, rationalisation of management and operation of power systems in *Japan* are tending to be accelerated. As a result, in the future a change is expected in the usual practice of operating thermal and hydro power plants in combination. Especially, recent progress in the technology of thermal power generation has advanced the reliability as well as the efficiency of thermal generation to such an extent that the mission imposed upon thermal power generation will gather more importance when those out-of-date thermal power plants now kept under operation out of sheer necessity will have been completely replaced by newly constructed modern large-scale thermal power plants.

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Abteilung Section Sous-section	G	Bericht Paper Rapport	37 $G_1/21$	Japan Japan Japon

Recent Advances in the Thermal Power Plant Equipment in Japan

by
Yoshisuke AIBE
Director of the Society of Thermal Power Engineers of Japan

I. Introduction

Japanese manufacturing techniques of thermal power plant equipments, which had advanced to the highest level in the world in pre-war days, failed to maintain for some years the degree of perfection formerly achieved, due to the exigencies of World War II. However, with the reconstruction of various industries after the termination of hostilities, rapid progress was achieved again, as demonstrated by the outstanding success realized partly through the introduction and assimilation of up-to-date foreign techniques. Particularly remarkable developments such as the increase in pressure and temperature, increase in turbine-generator output and speed, and the use of hydrogen cooling systems for generators, have allowed higher efficiencies of power generation; at the same time, the utilization of low grade coal, typical for the Japanese coal situation, for power generation must be noted. Moreover various new designs have been employed in equipments for industrial power plants.

Many power plant equipments of medium and smaller sizes have been exported to foreign countries.

A brief description of the latest developments along these lines follows.

II. Boilers

1. Large Capacity High Pressure and High Temperature Boilers

With the marked progress in design, workmanship and metallurgy, steam conditions have been rising continuously. The reliability, greatly increased by this technical progress, has improved boiler output and reduced the number

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Abteilung Section Sous-section	A	Bericht Paper Rapport	38 A/7	Japan Japan Japon

Japan's Energy Resources, Present and Future

By Dr. KOICHI AKI
Vice-Chairman, Resources Council
Prime Minister's Office, Japanese Government

I. Introduction

1. Among the industrialised countries throughout the world, *Japan* can be said to be confronting with the most difficult situation in its supply of energy. Industrialisation in *Japan* was started in the 1880's and its later phenomenal development owes much to the favorable increase in the supply of her indigenous energy, namely, the indigenous coal output which in 1880 was only 882 000 tons, but increased to 7 427 000 tons in 1900, to 29 245 000 tons in 1920, and to the peak in 1940 with an output of 56 313 000 tons. From toward the end of the 19th century, hydroelectric power became available in *Japan*, the annual output not being more than 447 million kWh in 1910. Expansion was, however, rapid since 1920 when generation increased from 3300 million kWh to 24 430 million kWh in 1940, and to 45 300 million kWh in 1954. Cheap and ample electric power supply played a great part in developing favorably the electrochemistry and the electro-metallurgy industries in *Japan* since 1930.

2. During the economic chaos which developed after the Second World War, the Japanese Government placed great importance on the production of coal. As a result, the output which dropped in 1946 to only 20 386 000 tons jumped to 38 459 000 tons in 1950, and to 46 531 000 tons in 1953. Hydro electric power development was stopped after the War, but was resumed in or around 1950. With the subsequent enactment of the *Electric Power Develop-*

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Abteilung Section Sous-section	A	Bericht Paper Rapport	41 A/8	Australien Australia Australie

The Present State of Power Production and Utilisation in Australia and its Development since 1950

By The Australian National Committee

Introduction

Since the abandonment of the *Glen Davis (N. S. W.)* shale oil project in May 1952, the energy resources of *Australia* have been confined, substantially, to solid fuels and water power. Of the former, coal is the greatly predominant source of power.

The figures for coal given below were determined by the *Australian National Committee* in consultation with the several *State Departments* of *Mines*, and are intended to indicate the probable total quantities of fuel extractable under current working conditions in *Australia*. The figures thus include those classified as "measured" and "indicated" by some other authorities.

General

Coal. According to the latest available estimates the total reserves of extractable anthracitic and bituminous coals in *Australia* amount to 15.25×10^9 tons[1], or 15.5×10^{12} kg, which, with an average calorific value of 11,500 B. Th. U. per lb (6,800 kcal per kg) represents heat energy reserves from this source amounting to about 10×10^{16} kcal. From 1950 to 1954, inclusive, the average figure for anthracitic and bituminous coal mined was about 17.0×10^6 tons annually and production now appears to be stabilised around 18.0×10^6 tons (say 18.3×10^9 kg) representing an annual withdrawal of 12.4×10^{13} kcal of energy.

For sub-bituminous coal the total resources amount to 1.9×10^9 tons, which represents, for an average calorific value of 9,500 B. Th. U. per lb (5,500 kcal per kg) heat energy reserves of nearly 11×10^{12} kcal.

The extractable reserves of brown coal and lignites are estimated to amount to over 40×10^9 tons, but may considerably exceed that figure. With an

[1] In this paper "tons" refers to long tons of 2,240 lb (1,016 kg)

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Abteilung Section Sous-section A
Bericht Paper Rapport 46 A 9
Türkei Turkey Turquie

Recent Progresses (since 1950) Achieved in the Developments of Hydro and Thermal Resources of Electric Energy in Turkey

by

T. FIKRET SUER
Chairman, C. E. Ga. Tech., M. S. Iowa University, President of Public Utilities, Ministry of Public Works, Ankara, Turkey

Turkey emerged from the Ottoman era as the remnant of a formerly great empire extending in *Europe*, *Asia* and *Africa*. Today the *Turkish Republic*, founded 1923, occupies territory in both *Europe* and *Asia* of 296 503 square miles (777 000 square kilometers). 97 per cent consists of the Anatolian peninsula of *Asia Minor* and 3 per cent is in *Europe*. The population (U. N. estimate 1953) is 22 461 000.

The Turkish terrain, contrary to the general conception in some of the foreign countries, is as a whole rather a very rugged plateau, with hot dry summers and cold winters. Physically, the country is divided into a number of regions of quite different characteristics. *European Turkey (Thrace)* has a gently rolling terrain, well adapted to general farming. *Asiatic Turkey (Anatolia)* consists primarily of a large semi-arid central plateau some 1 000 meters above sea level, virtually surrounded by a ring of high mountains. These mountains shut off much of the rainfall from central *Anatolia* where cereals, produced under dry farming conditions, are the principal agricultural products.

To the south of the Anatolian central plateau, between the *Taurus Mountains* and the *Mediterranean Sea*, lies the *Adana* plain which is a very fertile delta region formed by three rivers, *Seyhan*, *Ceyhan*, *Berdan*. In this region large amounts of cotton, cereals and oil seeds are produced. West of the

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Abteilung Section Sous-section	B	Bericht Paper Rapport	52 B/4	Finnland Finland Finlande

An Investigation Made in Finland for Forecasting Power Consumption and Production

By Mr. Kauko HJELT, adjunct of the direction of Imatra Power Company

This report is limited to dealing only with the side of energy economy in *Finland* which is represented by consumption and production of electric power. The subject will be studied in the light of the results of an investigation, carried through in 1954 in order to forecast the consumption of electric energy during the period of 1954—1958, and the method used in this forecast is reported.

As a background it might be advisable to take a look at the development of electric energy consumption in *Finland* up till now, and to survey the factors causing primarily in the first place the future increase of the power demand of this country.

The Consumption and Production of Electric Energy in 1930—1954

The vigorous upward trend in the economic development of *Finland* in the 1930's is clearly reflected in the increase of consumption of electric energy. It rose from 1,175 GWh in 1930 to 2,690 GWh in 1938, for example on an average 11% annually (Fig. 1). The war brought about a halt to this development, and in the treaty of 1944 *Finland* lost about 25% of the water power then constructed, and the consumption of electric energy fell to 2,000 GWh. After the war an intensified construction of water power plants was started, and the production of electric energy rapidly rose, reaching already in 1946 the level which prevailed before the war. The consumption of power, disregarding the exceptionally dry years 1947—1948, has continuously grown at a high speed, being in 1954 about 5,480 GWh. (These figures do not include surplus energy used in electric boilers for steam generation.) During the ten post-war years for example 1945—1954 the average annual rate of increase was